In this technological age, mathematics is more important than ever. When students leave school, they are more and more likely to use mathematics in their work and everyday lives — operating computer equipment, planning timelines and schedules, reading and interpreting data, comparing prices, managing personal finances, and completing other problem-solving tasks. What they learn in mathematics and how they learn it will provide an excellent preparation for a challenging and ever-changing future.

The state of Indiana has established the following mathematics standards to make clear to teachers, students, and parents what knowledge, understanding, and skills students should acquire in Grade 7:

Standard 1 — Number Sense

Understanding the number system is the basis of mathematics. Students extend this understanding to include irrational numbers, such as π and the square root of 2. They compare and order rational and irrational numbers and convert terminating decimals into fractions. They also use exponents to write whole numbers in scientific notation and to write the prime factorizations of numbers.

Standard 2 — Computation

Fluency in computation is essential. Students add, subtract, multiply, and divide integers, fractions, and decimals. They solve problems using percentages, including calculating discounts, markups, and commissions. They use mental arithmetic to compute with simple fractions, decimals, and powers.

Standard 3 — Algebra and Functions

Algebra is a language of patterns, rules, and symbols. Students at this level use variables and other symbols to translate verbal descriptions into equations and formulas. They write and solve linear equations and inequalities, and write and use formulas to solve problems. They also use properties of the rational numbers to evaluate and simplify algebraic expressions, and they further extend their understanding of graphs by investigating rates of change for linear and nonlinear functions and by developing and using the concept of the slope of a straight line.

Standard 4 — Geometry

Students learn about geometric shapes and develop a sense of space. They link geometry to coordinate graphs, using them to plot shapes, calculate lengths and areas, and find images under transformations. They understand the Pythagorean Theorem and use it to find lengths in right triangles. They also construct nets (two-dimensional patterns) for three-dimensional objects, such as prisms, pyramids, cylinders, and cones.

Standard 5 — Measurement

The study of measurement is essential because of its uses in many aspects of everyday life. Students measure in order to compare lengths, areas, volumes, weights, times, temperatures, etc. They develop the concept of similarity and use it to make scale drawings and scale models and to solve problems relating to these drawings and models. They find areas and perimeters of two-dimensional shapes and volumes and surface areas of three-dimensional shapes, including irregular shapes made up of more basic shapes.

Standard 6 — Data Analysis and Probability

Data are all around us — in newspapers and magazines, in television news and commercials, in quality control for manufacturing — and students need to learn how to understand data. At this level, they learn how to display data in bar, line, and circle graphs and in stem-and-leaf plots. They analyze data displays to find whether they are misleading and analyze the wording of survey questions to tell whether these could influence the results. They find the probability of disjoint events. They also find the number of arrangements of objects using a tree diagram.

Standard 7 — Problem Solving

In a general sense, mathematics is problem solving. In all mathematics, students use problem-solving skills: they choose how to approach a problem, they explain their reasoning, and they check their results. As they develop their skills with irrational numbers, analyzing graphs, or finding surface areas, for example, students move from simple ideas to more complex ones by taking logical steps that build a better understanding of mathematics.

As part of their instruction and assessment, students should also develop the following learning skills by Grade 12 that are woven throughout the mathematics standards:

Communication

The ability to read, write, listen, ask questions, think, and communicate about math will develop and deepen students' understanding of mathematical concepts. Students should read text, data, tables, and graphs with comprehension and understanding. Their writing should be detailed and coherent, and they should use correct mathematical vocabulary. Students should write to explain answers, justify mathematical reasoning, and describe problem-solving strategies.

Reasoning and Proof

Mathematics is developed by using known ideas and concepts to develop others. Repeated addition becomes multiplication. Multiplication of numbers less than ten can be extended to numbers less than one hundred and then to the entire number system. Knowing how to find the area of a right triangle extends to all right triangles. Extending patterns, finding even numbers, developing formulas, and proving the Pythagorean Theorem are all examples of mathematical reasoning. Students should learn to observe, generalize, make assumptions from known information, and test their assumptions.

Representation

The language of mathematics is expressed in words, symbols, formulas, equations, graphs, and data displays. The concept of one-fourth may be described as a quarter, ¼, one divided by four, 0.25, ⅛ + ⅛, 25 percent, or an appropriately shaded portion of a pie graph. Higher-level mathematics involves the use of more powerful representations: exponents, logarithms, π, unknowns, statistical representation, algebraic and geometric expressions. Mathematical operations are expressed as representations: +, =, divide, square. Representations are dynamic tools for solving problems and communicating and expressing mathematical ideas and concepts.

Connections

Connecting mathematical concepts includes linking new ideas to related ideas learned previously, helping students to see mathematics as a unified body of knowledge whose concepts build upon each other. Major emphasis should be given to ideas and concepts across mathematical content areas that help students see that mathematics is a web of closely connected ideas (algebra, geometry, the entire number system). Mathematics is also the common language of many other disciplines (science, technology, finance, social science, geography) and students should learn mathematical concepts used in those disciplines. Finally, students should connect their mathematical learning to appropriate real-world contexts.

Standard 1

Number Sense

Students understand and use scientific notation and square roots. They convert between fractions and decimals.*

7.1.1 Read, write, compare, and solve problems using whole numbers in scientific notation.

Example: Write 300,000 in scientific notation.

7.1.2 Compare and order rational* and common irrational* numbers and place them on a number line.

Example: Place in order: -2, $\frac{5}{8}$, -2.45, 0.9, π, $-1\frac{3}{4}$.

7.1.3 Identify rational and common irrational numbers from a list.

Example: Name all the irrational numbers in the list: -2, $\frac{5}{8}$, -2.45, 0.9, π, $-1\frac{3}{4}$.

7.1.4 Understand and compute whole number powers of whole numbers.

Example: $3^5 = 3 \times 3 \times 3 \times 3 \times 3 = ?$.

7.1.5 Find the prime factorization* of whole numbers and write the results using exponents.

Example: $24 = 2 \times 2 \times 2 \times 3 = 2^3 \times 3$.

7.1.6 Understand and apply the concept of square root.

Example: Explain how you can find the length of the hypotenuse of a right triangle with legs that measure 5 cm and 12 cm.

7.1.7 Convert terminating decimals* into reduced fractions.

Example: Write 0.95 as a fraction.

* scientific notation: a shorthand way of writing numbers using powers of ten (e.g., $300{,}000 = 3 \times 10^5$)

* rational number: a real number that can be written as a ratio of two integers* (e.g., $\frac{1}{2}$, $\frac{5}{6}$, $\frac{23}{9}$)

* integer: …, -3, -2, -1, 0, 1, 2, 3, …

* irrational number: a real number that cannot be written as a ratio of two integers (e.g., π, $\sqrt{3}$, 7π)

* prime factors: e.g., prime factors of 12 are 2 and 3, the two prime numbers that divide 12

* terminating decimals: decimals that do not continue indefinitely (e.g., 0.362, 34.1857)

Standard 2

Computation

Students solve problems involving integers, fractions, decimals, ratios, and percentages.*

7.2.1 Solve addition, subtraction, multiplication, and division problems that use integers, fractions, decimals, and combinations of the four operations.

Example: The temperature one day is 5°. It then falls by 3° each day for 4 days and, after that, rises by 2° each day for 3 days. What is the temperature on the last day? Explain your method.

7.2.2 Calculate the percentage increase and decrease of a quantity.

Example: The population of a country was 36 million in 1990 and it rose to 41.4 million during the 1990s. What was the percentage increase in the population?

7.2.3 Solve problems that involve discounts, markups, and commissions.

Example: A merchant buys CDs for $11 wholesale and marks up the price by 35%. What is the retail price?

7.2.4 Use estimation to decide whether answers are reasonable in problems involving fractions and decimals.

Example: Your friend says that $3\frac{3}{8} \times 2\frac{2}{9} = 10$. Without solving, explain why you think the answer is wrong.

7.2.5 Use mental arithmetic to compute with simple fractions, decimals, and powers.

Example: Find 3^4 without using pencil and paper.

* integer: …, -3, -2, -1, 0, 1, 2, 3, …

Standard 3

Algebra and Functions

Students express quantitative relationships using algebraic terminology, expressions, equations, inequalities, and graphs.

7.3.1 Use variables and appropriate operations to write an expression, a formula, an equation, or an inequality that represents a verbal description.

Example: Write in symbols the inequality: 5 less than twice the number is greater than 42.

7.3.2 Write and solve two-step linear equations and inequalities in one variable and check the answers.

Example: Solve the equation $4x - 7 = 12$ and check your answer in the original equation.

7.3.3 Use correct algebraic terminology, such as variable, equation, term, coefficient*, inequality, expression, and constant.

Example: Name the variable, terms, and coefficient in this equation: $7x + 4 = 67$.

7.3.4 **Evaluate numerical expressions and simplify algebraic expressions by applying the correct order of operations and the properties of rational numbers* (e.g., identity, inverse, commutative*, associative*, distributive properties*). Justify each step in the process.**

Example: Simplify $3(4x + 5x - 1) + 2(x + 3)$ by removing the parentheses and rearranging. Explain each step you take.

7.3.5 **Solve an equation or formula with two variables for a particular variable.**

Example: Solve the formula $C = 2\pi r$ for r.

7.3.6 **Define slope as vertical change per unit of horizontal change and recognize that a straight line has constant slope or rate of change.**

Example: Examine a table of values and make a conjecture about whether the table represents a linear function.

7.3.7 **Find the slope of a line from its graph.**

Example: Draw the graph of $y = 2x - 1$. Choose two points on the graph and divide the change in y-value by the change in x-value. Repeat this for other pairs of points on the graph. What do you notice?

7.3.8 **Draw the graph of a line given the slope and one point on the line, or two points on the line.**

Example: Draw the graph of the equation with slope of 3 and passing through the point with coordinates (0, -2).

7.3.9 **Identify functions as linear or nonlinear and examine their characteristics in tables, graphs, and equations.**

Example: A plant is growing taller according to the formula $H = 2d + 3$, where H is the height after d days. Draw the graph of this function and explain what the point where it meets the vertical axis represents. Is this graph linear or nonlinear?

7.3.10 **Identify and describe situations with constant or varying rates of change and know that a constant rate of change describes a linear function.**

Example: In the last example, how will the graph be different if the plant's speed of growth changes?

* coefficient: e.g., 7 is the coefficient in $7x$

* rational number: a real number that can be written as a ratio of two integers* (e.g., $\frac{1}{2}$, $\frac{5}{6}$, $\frac{23}{9}$)

* integer: …, -3, -2, -1, 0, 1, 2, 3, …

* commutative property: the order when adding or multiplying numbers makes no difference (e.g., $5 + 3 = 3 + 5$), but note that this is not true for subtraction or division

* associative property: the grouping when adding or multiplying numbers makes no difference (e.g., in $5 + 3 + 2$, adding 5 and 3 and then adding 2 is the same as 5 added to $3 + 2$), but note that this is not true for subtraction or division

* distributive property: e.g., $3(5 + 2) = (3 \times 5) + (3 \times 2)$

Standard 4

Geometry

Students deepen their understanding of plane and solid geometric shapes by constructing shapes that meet given conditions and by identifying attributes of shapes.

7.4.1 Understand coordinate graphs and use them to plot simple shapes, find lengths and areas related to the shapes, and find images under translations (slides), rotations (turns), and reflections (flips).

Example: Draw the triangle with vertices (0, 0), (3, 0), and (0, 4). Find the lengths of the sides and the area of the triangle. Translate (slide) the triangle 2 units to the right. What are the coordinates of the new triangle?

7.4.2 Understand that transformations such as slides, turns, and flips preserve the length of segments, and that figures resulting from slides, turns, and flips are congruent* to the original figures.

Example: In the last example, find the lengths of the sides and the area of the new triangle. Discuss your results.

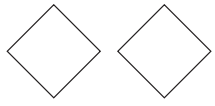
7.4.3 Know and understand the Pythagorean Theorem and use it to find the length of the missing side of a right triangle and the lengths of other line segments. Use direct measurement to test conjectures about triangles.

Example: Use the length and width of your classroom to calculate the distance across the room diagonally. Check by measuring.

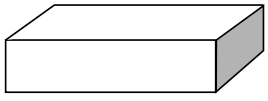
7.4.4 Construct two-dimensional patterns (nets) for three-dimensional objects, such as right prisms*, pyramids, cylinders, and cones.

Example: Draw a rectangle and two circles that will fit together to make a cylinder.

* congruent: the term to describe two figures that are the same shape and size



* right prism: a three-dimensional shape with two congruent ends that are polygons and all other faces are rectangles



Standard 5

Measurement

Students compare units of measure and use similarity to solve problems. They compute the perimeter, area, and volume of common geometric objects and use the results to find measures of less regular objects.*

7.5.1 Compare lengths, areas, volumes, weights, capacities, times, and temperatures within measurement systems.

Example: The area of the school field is 3 acres. How many square yards is that? Explain your method.

7.5.2 Use experimentation and modeling to visualize similarity problems. Solve problems using similarity.

Example: At a certain time, the shadow of your school building is 36 feet long. At the same time, the shadow of a yardstick held vertically is 4 feet long. How high is the school building?

7.5.3 **Read and create drawings made to scale, construct scale models, and solve problems related to scale.**

Example: On a plan of your school, your classroom is 5 cm long and 3 cm wide. The actual classroom is 10 m long. How wide is it? Explain your answer.

7.5.4 **Use formulas for finding the perimeter and area of basic two-dimensional shapes and the surface area and volume of basic three-dimensional shapes, including rectangles, parallelograms*, trapezoids*, triangles, circles, right prisms*, and cylinders.**

Example: Find the surface area of a cylindrical can 15 cm high and with a diameter of 8 cm.

7.5.5 **Estimate and compute the area of more complex or irregular two-dimensional shapes by dividing them into more basic shapes.**

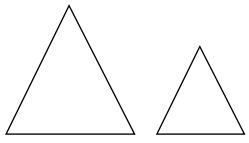
Example: A room to be carpeted is a rectangle 5 m × 4 m. A semicircular fireplace of diameter 1.5 m takes up some of the floor space. Find the area to be carpeted.

7.5.6 **Use objects and geometry modeling tools to compute the surface area of the faces and the volume of a three-dimensional object built from rectangular solids.**

Example: Build a model of an apartment building with blocks. Find its volume and total surface area.

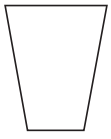
7

* similar: the term to describe figures that have the same shape but may not have the same size

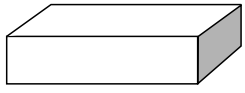


* parallelogram: a four-sided figure with both pairs of opposite sides parallel

* trapezoid: a four-sided figure with one pair of opposite sides parallel



* right prism: a three-dimensional shape with two congruent ends that are polygons and all other faces are rectangles



Standard 6

Data Analysis and Probability

Students collect, organize, and represent data sets and identify relationships among variables within a data set. They determine probabilities and use them to make predictions about events.

7.6.1 Analyze, interpret, and display data in appropriate bar, line, and circle graphs and stem-and-leaf plots* and justify the choice of display.

Example: You survey the students in your school to find which of three designs for a magazine cover they prefer. To display the results, which would be more appropriate: a bar chart or a circle graph? Explain your answer.

7.6.2 Make predictions from statistical data.

Example: Record the temperature and weather conditions (sunny, cloudy, or rainy) at 1 p.m. each day for two weeks. In the third week, use your results to predict the temperature from the weather conditions.

7.6.3 Describe how additional data, particularly outliers, added to a data set may affect the mean*, median*, and mode*.

Example: You measure the heights of the students in your grade on a day when the basketball team is playing an away game. Later you measure the players on the team and include them in your data. What kind of effect will including the team have on the mean, median, and mode? Explain your answer.

7

7.6.4 Analyze data displays, including ways that they can be misleading. Analyze ways in which the wording of questions can influence survey results.

Example: On a bar graph of a company's sales, it appears that sales have more than doubled since last year. Then you notice that the vertical axis starts at $5 million and can see that sales have in fact increased from $5.5 million to $6.2 million.

7.6.5 Know that if P is the probability of an event occurring, then $1 - P$ is the probability of that event not occurring.

Example: The weather forecast says that the probability of rain today is 0.3. What is the probability that it won't rain?

7.6.6 Understand that the probability of either one or the other of two disjoint events* occurring is the sum of the two individual probabilities.

Example: Find the probability of rolling 9 with two number cubes. Also find the probability of rolling 10. What is the probability of rolling 9 or 10?

7.6.7 Find the number of possible arrangements of several objects using a tree diagram.

Example: A state's license plates contain 6 digits and one letter. How many different license plates can be made if the letter must always be in the third position and the first digit cannot be a zero?

* stem-and-leaf plot: e.g., this one shows 62, 63, 67, 71, 75, 75, 76, etc.

Stem	Leaf
6	2 3 7
7	1 5 5 6 8 9
8	0 1 1 2 3 5 5 7 8 8
9	1 2 2 3 3 4

* mean: the average obtained by adding the values and dividing by the number of values
* median: the value that divides a set of data, written in order of size, into two equal parts
* mode: the most common value in a given data set
* disjoint events: events that cannot happen at the same time

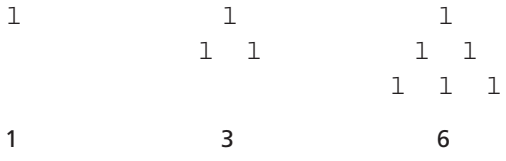
Standard 7

Problem Solving

Students make decisions about how to approach problems and communicate their ideas.

7.7.1 **Analyze problems by identifying relationships, telling relevant from irrelevant information, identifying missing information, sequencing and prioritizing information, and observing patterns.**

Example: Solve the problem: "The first three triangular numbers are shown in the diagram below. Find an expression to calculate the nth triangular number."



Decide to look for patterns.

7.7.2 **Make and justify mathematical conjectures based on a general description of a mathematical question or problem.**

Example: In the first example, notice that three dots make an equilateral triangle for the number 3 and six dots make the next equilateral triangle.

7.7.3 **Decide when and how to divide a problem into simpler parts.**

Example: In the first example, decide to make a diagram for the fourth and fifth triangular numbers.

Students use strategies, skills, and concepts in finding and communicating solutions to problems.

7.7.4 Apply strategies and results from simpler problems to solve more complex problems.

Example: In the first example, list the differences between any two triangular numbers.

7.7.5 Make and test conjectures by using inductive reasoning.

Example: In the first example, predict the difference between the fifth and sixth numbers and use this to predict the sixth triangular number. Make a diagram to test your conjecture.

7.7.6 Express solutions clearly and logically by using the appropriate mathematical terms and notation. Support solutions with evidence in both verbal and symbolic work.

Example: In the first example, use words, numbers, and tables to summarize your work with triangular numbers.

7.7.7 Recognize the relative advantages of exact and approximate solutions to problems and give answers to a specified degree of accuracy.

Example: Calculate the amount of aluminum needed to make a can with diameter 10 cm that is 15 cm high and 1 mm thick. Take π as 3.14 and give your answer to appropriate accuracy.

7.7.8 Select and apply appropriate methods for estimating results of rational-number computations.

Example: Measure the dimensions of a swimming pool to find its volume. Estimate an answer by working with an average depth.

7.7.9 Use graphing to estimate solutions and check the estimates with analytic approaches.

Example: Use a graphing calculator to find the crossing point of the straight lines $y = 2x + 3$ and $x + y = 10$. Confirm your answer by checking it in the equations.

7.7.10 Make precise calculations and check the validity of the results in the context of the problem.

Example: In the first example, check that your later results fit with your earlier ones. If they do not, repeat the calculations to make sure.

Students determine when a solution is complete and reasonable and move beyond a particular problem by generalizing to other situations.

7.7.11 Decide whether a solution is reasonable in the context of the original situation.

Example: In the first example, calculate the 10^{th} triangular number and draw the triangle of dots that goes with it.

7.7.12 Note the method of finding the solution and show a conceptual understanding of the method by solving similar problems.

Example: Use your method from the first example to investigate pentagonal numbers.